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LXIV.—*Some Earthworms from Celebes.* By W. BLAXLAND BENHAM, D.Sc. (Lond.), Hon. M.A. (Oxon.), Aldrichian Demonstrator in Comparative Anatomy, Oxford.

[Plates XX. & XXI.]

ALTHOUGH a considerable number of species of the large genus *Perichæta* have been described from the Malay Archipelago by Horst, Rosa, Beddard, and myself, yet none have been collected, so far as I am aware, on the island of Celebes; at any rate, none are recorded in Beddard's monograph. I was therefore very glad to have the opportunity of examining a small collection from this island and from Jampea, due south of it, made by Mr. H. Everett and presented to the British Museum, and placed in my hands for identification by Prof. Bell, to whom my best thanks are due.

The twelve worms which form the collection fall into at least six groups, none of which agree with any species hitherto known. As so frequently happens, some of these new species are represented by one specimen.

For the more ready comparison with already existing species, I append to each description of the anatomy of the individual a summary of what I regard as the characteristic features, in the form of a diagnosis. Such a diagnosis is of no value till other specimens are found; but I have much felt

the absence of such a brief *résumé* in many instances whilst reading through the literature of the genus.

Perichæta jampeana, sp. n. (Pl. XX. fig. 1.)

Three specimens are included in this species.

The colour is a nearly uniform dark olive-green on the back; the chætal bands, so usually present in the genus, are here no lighter than the ground-colour. The worm is not perceptibly darker anteriorly. The dark colour extends well round on to the ventral surface, leaving a light stripe with a pinkish tint running along the middle third of the ventral surface; measured on the dissected specimen this stripe is 7 millim. broad, the circumference of the worm being 36 millim. But the anterior end of the body for about the first twenty-six segments does not present this light ventral band; here the dark greenish tint extends right round the body, over a very unusual number of segments, and the ventral surface is scarcely lighter than the back. One specimen was "mottled" on the upper surface with pinkish patches, some large, others small, irregular and varied in shape.

The clitellum is nearly black, though with a bluish tint.

The worm is, except in front of the clitellum, of about the same diameter throughout; the posterior end is very suddenly rounded, so as to appear almost truncate.

Two of the specimens measure 315×12 and 310×10 millim. respectively, and the former consists of 150 segments.

The *clitellum*, which occupies the normal three segments, is not swollen, presents a trace of the intersegmental grooves, but no chætae.

The *male pores* are conspicuous as wide depressions in a pinkish circular area; the eighteenth segment has a pink dumb-bell-shaped area, with a slight papilla at each end; in this papilla is the pore itself: the outer lip is rounded and prominent, but not sharply marked; the inner lip scarcely exists, as the surface slopes down gradually to the pore.

Between the two pores are 13 or 14 chætae (fig. 1 a).

It may be mentioned that the distance between the pores, as measured by compasses the points of which were placed in the pores, is 5, 6, and 8 millim. respectively, the last in a very soft specimen.

The *spermathecal pores* are between segments vii./viii., viii./ix., each in a small pinkish area; about 19 or 20 chætae between pores.

There are no copulatory papillæ.

The *chætæ* form a complete circle, without any perceptible dorsal or ventral gap.

I counted on the body 70 *chætæ* on segment iii.

70	„	„	ix.
100	„	„	xxiv.

The first *dorsal pore* is between segments xii./xiii., though possibly it occurs earlier, as the worms are strongly contracted; in front of the clitellum it is impossible to see the pore.

The *internal anatomy* presents the usual characters of a "*Perichaeta*" (s. str.) as regards gizzard, septa, heart, and cæcum. The last, however, presents this peculiarity, that it is deeply notched externally, so that, in addition to the long main cæcum, some 11 or 12 secondary cæca arise from its base. (See the description of *P. digitata*.)

There are two pairs of *spermathecæ* in segments viii. and ix.; each is a nearly spherical sac, with a short narrow duct, into which opens a long undulating diverticulum, slightly dilated terminally to form a somewhat oval sac (fig. 1c). The anterior spermatheca on each side is about half the size of that in the ninth segment.

The *spermiducal gland* is relatively small; it is confined to segment xviii., though it pushes the posterior septum back nearly to the next septum. Roughly speaking, the gland is triangular when viewed from above, compact, only slightly notched (fig. 1b). The duct, which is stout and short, runs alongside it in an obliquely longitudinal direction; but the gland itself really underlies the hinder part of the duct, so as to appear from below it on its mesial side.

I noted nothing else characteristic in the worm.

The comparatively large size of this worm allows only a few species to be compared with it, and of those occurring in the same region none appear to resemble it in colour. But I find that authors frequently omit a careful description of colour; and although Beddard has insisted on its importance, he himself, in recent papers (Monograph, and P. Z. S. 1895 and 1896), says little about it. As for structural characters, this worm approaches none of the other species closely. Most of the worms with two pairs of spermathecæ in segments viii. and ix. are much smaller, and amongst the non-papillate species there are none that can be pointed to as like it in its totality of characters.

The diagnosis of the species is as follows:—

Dark olive-green; measuring 315 × 10 millim.; 150 segments.

Male pores large, at each end of dumb-bell-shaped

area; no copulatory papillæ. Spermathecæ in segments viii. and ix.; pores on anterior margins; a globular sac, with narrow (undulating) diverticulum, expanded terminally. Dorsal pore xii./xiii. Chætal ring complete, 70 chætæ in front of and 100 behind clitellum. Pair of cæca in xxvii., the base incised to form about 12 secondary cæca. Spermiducal gland small, triangular, confined to xviii.; duct thick, short, not curved; no muscular bulb.

Hab. Jampea Island, south of Celebes.

Perichæta digitata, sp. n. (Pl. XX. fig. 2.)

A single specimen serves for the foundation of this new species. It is rather smaller than the preceding, measuring 240×15 millim. at its thickest part.

It is rather pointed at each end, and especially at the tail, where the last dozen segments taper to a point; this difference may, of course, be due to preservation.

The general colour is lighter and of quite a different tone to that of the preceding, being a stony grey, with very slight greenish tint, and passing posteriorly into a distinct French grey. There is no banding, the chætal rings being no lighter than the rest; but the anterior part of the worm is lighter, not darker, as is almost universally the case, being much mottled with pinkish-white spots, irregular in arrangement and size, but all small. This mottling, which is a very unusual kind of marking in earthworms, diminishes behind the clitellum, the spots getting fewer and smaller, and ultimately ceasing.

The pigment does not extend so far down the sides as in the preceding worm, and the ventral surface of the anterior segments is light, this band being so wide as to take in the male and spermathecal pores. The ventral surface is generally a very light brown.

The clitellum is brown, but with an olive-green tint about it, and only slightly darker than the rest of the body.

The worm consists of 126 segments.

The *clitellum* is on the usual segments, but apparently not quite fully developed, as dorsal pores can be detected, and on the ventral surface of the segments xiv., xv., xvi. is a row of 18 or 20 chætæ. Whether these would be permanent must be left undecided.

The first *dorsal pore* is between segments xii./xiii.

The *male pores*, which are 6 millim. apart and are separated

by 14 chætæ, are wide deep pits with fairly well-marked lips, which are raised up and lighter in colour than the surrounding surface. Indeed, this region resembles that of *P. jampeana* if we imagine that that species had been much more contracted.

There are two pairs of *spermathecal pores*—between segments vii./viii., viii./ix.—at about the level of the seventh and eighth chætæ from the middle line.

The *chætæ* do not form quite a complete circle, as there is a dorsal gap behind the clitellum which, though subject to variations, is always greater than twice the normal interchætal gap. This dorsal gap is scarcely recognizable on the first six segments.

The ventral gap is smaller behind the clitellum, though distinct enough in front of it, where it is about twice the normal interchætal gap. Posteriorly it gets more nearly to equal this gap, and thus is not so readily recognizable.

The chætæ do not appear to be so closely set as in the preceding species. There are 30 chætæ on the left side in segment iii.; many had apparently dropped out on the right side, and the worm was too much hardened to remove the cuticle successfully. We may regard 60 as approximately the number on segment iii.

98 on segment vii.

100 " xiii.

99 " xx.

100 on a segment much further back.

It is worthy of note that the chætæ along the side are smaller and closer together than above or below.

Internal anatomy.—In addition to the thick septa round the pharynx, those between the following segments—x./xi., xi./xii., xii./xiii., xiii./xiv.—are very much thicker than the rest. Septum xiv./xv. is much thinner than these, but is thicker than the following ones.

Some stress, perhaps too much, has been laid upon the number of thickened septa, so that I have paid some attention to them in these worms; but, so far as my experience goes, they are not of importance as specific characters, though it is possible that they may characterize allied groups of species.

There is a trace of septum viii./ix.

The *gizzard* occupies segments viii. and ix.—that is to say that the space between the two septa vii./viii. and x./xi. is not wholly occupied by the gizzard, but a small part of the cesophagus equal to about the length of a segment intervenes between the gizzard and the septum x./xi.

The most striking and interesting as well as novel feature

about the alimentary system is presented by the conditions of the *cæcum*. It is usually stated that these pouches lie in the twenty-sixth segment. From an examination of my material I believe that they in reality belong to the twenty-seventh segment, but, being closely adpressed to the intestine in this segment and passing through the septum in front, so as to lie freely in segment xxvi., it appears at first sight that they belong to this latter segment. In the new species herein considered I carefully examined this point, and find that the *cæcum originates from the intestine in the twenty-seventh segment*; the communication is wide and occupies nearly all this segment.

In the present worm the *cæcum* is of considerable size; it rises by a broad base in the twenty-seventh segment, runs forward through the twenty-sixth, and extends to the anterior boundary of the twenty-fifth segment. Its wall is not entirely smooth, but along its dorsal (inner) and ventral (outer) side is notched, and these notches on the outer side become deeper as the base of the *cæcum* is approached, so as to produce secondary *cæca* or finger-shaped lobes. Of these one arises in the twenty-sixth segment close to the posterior septum, the rest arise in the twenty-seventh segment. There are about a dozen of these finger-shaped secondary *cæca*, arranged along the outer side of the base of the *cæcum* and tending to become smaller as the lower ventral surface of the gut is reached. Some of these secondary *cæca* arise as bifurcations of a simple lobe (as in figure 2 c).

Hitherto only a few species have been recorded in which more than a single pair of *cæca* are present, viz. *P. Hilgendorffi*, *P. Sieboldii*, *P. Gulielmi*, *P. mandhorensis*, and occasionally in *P. musica*, and in a new species of Beddard's—*P. trityphla*—from the Sandwich Islands. Probably in all these cases the mode of origin of these additional *cæca* is the same, as they are described as lying one above the other, to the number of three to six, according to the species; but in none are they so numerous as in the present species, hence the specific name "*digitata*."

The *vascular system* presents the following features:—

There are two pairs of latero-intestinal hearts in segments xii. and xiii., each being connected dorsally with the large dorsal trunk and the much smaller supra-intestinal vessel. In segment xi. there is an "intestinal heart" connected only with the supra-intestinal vessel. The dorsal vessel continues forward as a narrow tube above the gizzard, giving off a pair of vessels just anterior to the septum x./xi.; a second pair in front of the hinder margin of the gizzard; another

pair just in front of the septum vii./viii. Apparently there is no vessel in segment viii., nor are there any in segments xiv. and xv.; but posteriorly in and after segment xvi. the dorsal vessel gives off a pair of nearly vertical vessels to body-wall as well as two pairs to gut.

The dorsal vessel is provided with a pair of "glycogenic glands" on each of the posterior segments.

With regard to the generative organs, there are two pairs of *sperm-sacs* in segments xi. and xii., of relatively small size and of smooth surface. How these are related to "sperm-bladders" ("Samenblasen") I cannot say, as I did not wish to injure the specimen too much, and I do not consider this point of great importance.

Grape-like *ovisacs* of large size lie in segment xiv. continuous with large sac-like oviducts.

The *spermathecæ* lie in segments viii. and ix., those of the eighth segment being about one fourth the size of the other pair. Each spermatheca consists of a somewhat pyriform sac with a long duct, into which opens an undulating diverticulum terminating in a slight dilatation (fig. 2 b).

This verbal description so closely resembles that given for *P. jumpeana*, that one might easily imagine that the two species had the same shaped spermathecæ; and it is a most important point, it seems to me, to illustrate these diagnostic organs in the *Perichæta*. A careful figure, to measurement for preference, will do more than many words of description to give an idea of the characters on which the species are founded. Many species of this difficult and extensive genus are known only from verbal descriptions, some of the terms employed being extremely "loose," and it is a matter of great difficulty to pick out the diagnostic characters of a species from a mere verbal description. Nevertheless, it must be borne in mind that the size and even shape of the main sac is liable to variation according to its state of repletion.

The same remarks apply to descriptions of the spermiducal gland: such terms as "compact," "loosish" in texture, unless accompanied by figures, are absolutely insufficient whereby to form a mental picture of the organ.

In the present species the *spermiducal gland* is entirely confined to the eighteenth segment and has a very characteristic form. It is arranged in the form of a horseshoe, the convexity outwards, embracing by its two limbs the thick straight duct. This duct passes at right angles to the long axis of the worm, then, after widening slightly, dips suddenly downwards, and runs under its former course, to gain the body-wall. There is no "muscular bulb." The gland appears

connected to the penial duct by three narrow delicate ducts, one from each limb and one from the bottom of the U-shaped gland (fig. 2 a).

I thought at first, seeing that there are several similarities between this and the preceding species, that the spermiducal gland might in reality be of the same shape, but in different positions, in the two worms. But I have been unable to place this gland in such a position as in the other worm so as to resemble it; further, there is no glandular substance below the duct such as there is in *P. jampeana*. The shape of this gland, in conjunction with the shape of the cæcum, is, indeed, very characteristic.

The difference in colour, in number of chætæ on the anterior segments, the existence of "gaps" in the circle of chætæ, the difference in the distance of the spermathecal pores from one another, in addition to the more conspicuous difference in the character of the spermiducal glands and of the spermathecæ, in these two worms from Jampea would seem to necessitate the formation of two species. Nevertheless for a long time I felt uncertain of the distinctness between them, since both agree in the peculiarity of the cæca, hitherto unrecorded, as well as in character of coloration, difference in size of the two spermathecæ on one side, &c., and I still hesitate as to whether this second worm may be only a variety of the species *P. jampeana*, for we know but very little as to the extent of "variation" in *Oligochæta*; but from facts derived from the study of other species in greater numbers, as well as from statements by Beddard, Rosa, and others, as to variations in structure in one and the same species, I think that it will be the better plan to form a separate species for it. Four worms are collected on an island, nearly the same in size and general anatomy, the points of difference being relatively small, the question arises—does it lead to less or to more confusion to give to each a new name, or to treat them as varieties of one species, till more specimens are known? If in the future it turns out that *P. digitata* is only a varietal form or an abnormality of *P. jampeana*, the name can be dropped.

The following is the diagnosis of the species:—

Stone-grey to French grey posteriorly; more or less mottled with lighter colour; measures 240 × 15 millim.; 126 or more segments. Male pores wide deep pits; no copulatory papillæ. Two pairs of spermathecæ in viii., ix., with anterior pores; pyriform sac, with long duct, receiving an undulating diverticulum, terminally dilated. Chætal ring with slight dorsal

and ventral gaps; about 100 chætæ, in front of and behind clitellum; chætæ smaller laterally. Dorsal pore xii./xiii. Paired cæca in xxvii., with about 12 secondary cæca arising from its base. Spermiducal gland horseshoe-shaped, embracing the wide, nearly straight duct; there is no muscular bulb.

Hab. Jampea Island, south of Celebes.

Perichæta bonthainensis, sp. n. (Pl. XX. fig. 3.)

One specimen only is referable to this species. It is about the same size as the last, but of quite a different colour. The posterior end is dilated, flattened, and as broad or even broader than the preclitellar region. One very noticeable feature about this end is the *large anus*, which is horizontal; so far as I can find recorded, this is quite peculiar. It may be suggested that the worm *may* have been compressed in packing; but there is no sign of that, and the outline of the anus is quite smooth and unpuckered, which would probably not be the case if a round anus had been compressed, perhaps irregularly or obliquely. Moreover, the anus is usually vertical in *Perichæta*. The anus is surrounded by a white, and this by a dark grey circle (fig. 3 d).

The colour of the worm is scarcely definable; it appears a good deal changed in spirit; one can only say that there is a bluish-grey narrow stripe along the back and rather lighter chætal bands; the general tone is lighter than in the preceding species. The first two segments, however, are violet. The clitellum is light brown and well marked, occupying the normal position, and is without chætæ. The ventral surface of the worm is buff.

The worm measures 280 × 17 millim. in front of clitellum; the diameter at the clitellum is 18 millim., and at the posterior end of the body 19 millim.; in middle of body only 13 millim.

The worm presents 107 segments.

Each *male pore* is a transverse slit or narrow depression on the top of a large round swollen area, lighter than the surrounding body. Each pore-bearing papilla or prominence occupies the whole length of the eighteenth segment, and carries immediately in front of the pore an oval area, which appears to be the remains of a glandular papilla (fig. 3 a).

Similar aræ lie on segments xvii., xix., xx. In the two former segments there is a median and a pair of lateral papillæ slightly outside the line of the male pore. In the twentieth the papilla of the left side is wanting.

I am by no means certain that these oval areas are really the remains of copulatory papillæ; a careful examination with a hand-lens shows that the epidermis is here rubbed off and the circular muscles exposed. But since this abrasion has affected spots symmetrically arranged and of the same size and shape (roughly), and no other such spots occur on the worm, I believe that the glandular epithelium of papillæ projecting from these spots, and looser in character, has been rubbed away; I have therefore figured them as papillæ. The same remarks apply equally to those in front of the male pores. There are only three chætæ between the two "porophores"*, and it appears to me that there is one chæta in the centre of each, immediately behind the male pore; the existence of only three chætæ here is, I believe, unique; the pores are 5 millim. apart. The oviducal pore is median, as usual.

The *spermathecal pores* are not visible.

The first *dorsal pore* is xii./xiii.

The *chætæ* present a slight dorsal gap, equal to about twice the normal gap; this is visible behind, but not recognizable in front of the clitellum; there is a very slight but distinct ventral gap.

The chætæ on segments ii., iii. are distinctly *smaller* than those on the body generally, while those on segments iv., v., vi. are slightly larger.

On segment ii. there are about 50 chætæ, though occasional gaps equal to about 6 or 8 occur.

On segment iii., 92.

„ xiii., 125.

„ xxvi., 128 or 130.

Internal anatomy.—There are two pairs of *spermathecae*, in segments viii. and ix., with anteriorly placed openings. There is no perceptible difference in size between the pairs. The "sac" is oval, with a short thick duct, not well marked off from the sac. The diverticulum, dilated at the end, but of rather a different shape to that of the preceding species, has its duct less undulating.

The *spermiducal gland* is large, occupying segments xvi., xvii., xviii., and of rather a peculiar form. The anterior part of the gland is thicker than the rest, and the edge stands up above the rest (fig. 3 b). It is possible, of course, that the apparently peculiar shape of the gland may be due to strong contraction of the worm. It is only slightly notched, and

* I suggest this term for the slight papillæ on which, in nearly all earthworms, the male pore is situated.

may be spoken of as compact; it is relatively thick. The duct is short, straight, and thick.

The septa between segments x./xi., xi./xii., xii./xiii., xiii./xiv. are very stout; the next two are also moderately thick. The following septa are quite thin and present peculiar *pouchings* above the dorsal vessel (Pl. XXI. fig. 3 e).

The septum xvi./xvii. has on its anterior face a thin-walled sac lying in segment xvi.—that is, in the segment in front; this sac communicates by a wide opening with segment xvii.—that is, with the segment behind the septum. Each sac is slightly lobed or sacculated, and contains, but is not filled by, a coagulum. Each of the following septa has a similar pouch upon it. Segment xvi. also contains, attached to its anterior septum, two long pyriform sacs, which are, on further examination, seen to be due to the bifurcation of a single pouch which communicates with the anterior segment, *i. e.* segment xv.

Beddard has described in *Acanthodrilus falclandicus* a somewhat similar condition, and in his Monograph groups these pouches of the septa with the solid structures attached to septa of *Perichæta indica*, and with other structures occurring at the sides of the dorsal vessels in certain other species, *e. g.* *P. Dyeri*.

The vascular system shows no differences from that described above.

The cæcum is notched and digitate to the same extent as in *P. digitata*, but the secondary cæca are more irregular in size, shape, and mode of origin (Pl. XX. fig. 3 c).

The close approximation of the male pores recalls the most striking external generic character of *Perionyx*; but it is not quite unique in the genus *Perichæta*, since it occurs also in *P. violacea*, from which the present species differs in the number of spermathecae. There can be no doubt that *P. jampeana*, *P. digitata*, and *P. bonthainensis* are very closely allied—a fact evidenced alike by the size, notable amongst *Perichætes*, and the extensive digitation of the cæcum.

The species may be diagnosed as follows:—

Bluish grey (?); measures 250 × 17 millim.; 107 segments. Male pores as transverse slits on prominent rounded area, embracing elongated oval papilla in front of the pore. Three papillæ symmetrically arranged in a row in front of the chætæ on each of the segments xvii., xix., xx. Only three chætæ between the porophores. Two pairs of spermathecae in viii., ix., opening anteriorly; sac ovate, short duct receiving an undulated

narrow diverticulum, dilated terminally; slight gaps in the ring of chætæ, which number about 90 in front of and 130 behind the clitellum, those on iv., v., vi. larger, and those on ii., iii. smaller, than on other segments. Dorsal pore xii./xiii. Paired cæca in xxvii. with secondary cæca. Spermiducal gland compact, ear-shaped, occupies segments xvi., xvii., xviii., not much incised, with thick nearly straight duct; no muscular bulb.

Hab. Bonthain Peak, Celebes.

Perichæta hexatheca, sp. n. (Pl. XXI. fig. 5.)

This species, again, is represented by a single specimen. It is pale brown, with white rings at the level of the chætæ. In the post-clitellar region there is a brown band running along the mid-dorsal line. The sides are pale and semi-transparent.

The worm measures 130×8 millim. and consists of 74 segments.

The *clitellum* is well marked, darker brown, with three whitish bands, but without chætæ.

Owing to the contraction of the ventral surface the *male pores* are brought close together and are separated by a fairly deep furrow, the bottom of which presents longitudinal folds of the cuticle (? of the body-wall as well). This furrow runs across segments xvii., xviii., and reminds one of the condition sometimes presented by Acanthodrilids. Each pore is small and rounded (fig. 5 a).

There are 8 *copulatory papillæ*, arranged as follows:—3 in a row on segment xx., 3 on xix., and 2 on xvii. It is possible that a median one exists here, but owing to the infolding of the wall I could see none; they are all situated in front of the chætal ring.

The *spermathecal pores*, of which there are *six pairs*, can scarcely be discerned externally; they lie in the grooves in front of the fourth to ninth segments, close to the middle line, about ten chætæ from one to the other.

The first *dorsal pore* is xii./xiii.

The *chætæ* form a complete ring. I was unable to pull the cuticle off in order to count the chætæ in the second segment. On the worm itself I counted 70 on segment vi., 80 or more on segment xiii., and more than 100 behind the clitellum; they are very small.

Internally, attention may be directed to the *cæcum*, arising

on segment xxvii., notched, as in the two preceding species, but with only three or four well-defined secondary cæca; and the lower part of base is traversed by furrows, indicating several other lobes.

There are six pairs of *spermathecæ*, but of these only the last two pairs in segments viii. and ix. are readily seen; in fact, I overlooked the four anterior pairs at first (fig. 5 *d*).

The sac of the last two pairs is very irregular in shape, shrunken, and notched, but apparently each is normally constricted about one third from the apex and marked with circular rings; the diverticulum is longer than the sac—or, at any rate, as long as it, for the diverticula varied on the two sides;—the duct is in the form of a zigzag, and is dilated terminally (fig. 5 *c*). The spermatheca in segment ix. is about half as long as the gizzard, that in segment viii. about half as large as that in segment ix.

The anterior four pairs are all very much smaller and diminish in size from behind forwards; in the case of the two pairs in segments v. and vi. the diverticulum is much larger than the sac, which is pyriform; in segment iv. there is only one structure, apparently the sac. This is very minute, can only be seen under a dissecting-lens, and is readily torn from the body; but I found it on both sides, and thus am in no doubt as to its being a real structure.

I can recall no species either with so many as six pairs of spermathecæ or in which such a difference in size between first and last occurs.

The *sperm-sacs* in segments xi. and xii. are lobulated; there are two *ovisacs* on each side in segments xiii. and xiv.

The *spermiducal gland* is unusually "compact" and relatively small (fig. 5 *b*). It consists essentially of three partially superposed long narrow lobes, with their longer axes at right angles to the axis of the body. The anterior lobe is highest when the worm is pinned out—that is, it is inmost in the natural position and pressed against the side of the intestine, so as to be concave on this surface. The other lobes project from below one another, as in the figure. The duct is slightly curved, lies transversely with concavity forwards. There is no muscular bulb.

Remarks.—Seeing that the first spermatheca is extremely small, probably vestigial, it occurred to me that perhaps this worm had already been described as one with five spermathecæ. Beddard gives two species in this condition, viz.:—

P. violacea, which is much smaller and different in every way; and

P. pentacystis, which, though about the same size, has a

pair of genital papillæ on each of segments xvii., xviii.; the shape of the spermathecæ is different; whilst the number of chætæ, the character of the spermiducal glands, &c., differentiate it from the present species.

The species may be diagnosed as follows:—

Pale brown, with white chætal rings; median dorsal brown stripe; measures 130×8 millim.; 74 segments. Male pores small and round, separated by deep furrow (? artifact); 3 copulatory papillæ in xix., xx., and 2 (? 3) in xvii. Six pairs of spermathecæ, opening anteriorly in iv. to ix., the four anterior smaller than the other two; the sacs irregularly pyriform, with circular furrows and constrictions; short duct, receiving an undulating diverticulum, longer than sac, and gradually dilating terminally. Chætal ring complete, about 80 chætæ in front of and 100 behind the clitellum. Dorsal pore xii./xiii. Paired cæca in xxvii., incised to form four secondary cæca. Spermiducal gland small, three parallel lobes; duct curved forwards from the hinder end; no muscular sac.

Hab. Bonthain Peak, Celebes.

Perichæta zebra, sp. n. (Pl. XX. fig. 4.)

This is represented by one specimen, and is very conspicuously marked with alternate dark and light bands; the dark bands, looking black with the cuticle on, are really deep purplish brown; the light bands are nearly white, slightly yellowish.

Behind the clitellum the light band—chætal band—is about half the size of the intersegmental dark band; this band extends downwards at the side, and then rather suddenly narrows to cross the ventral surface as a very narrow strip; this ventral band is reddish brown in colour. The ventral surface of the eighteenth segment is light; the dark bands in front and behind do not pass beyond the male pores.

On the clitellum the banding is still present, but the light band is brown instead of yellowish white.

In front of the clitellum the dark bands are nearly black, and each is divided into two by a very narrow intersegmental lighter line, scarcely recognizable without a lens.

The first segment is entirely dark, having no light band.

The worm measures 200×6 millim. behind the clitellum; it consists of 120 segments; the posterior end is pointed.

The *male pores* are far apart, being separated by about 10

chætæ* ; each is a deep crescentic pit, with overhanging outer rounded lip (somewhat as in *P. capensis* and *P. operculata*). This carries a small cup-shaped papilla. From the bottom of the pit I can see a rounded tubercle projecting—the duct, no doubt, of the spermiducal gland. It is indicated on the left side of the figure.

Further, between the male pores on xviii., in front of chætæ, are two other cupped papillæ (“suckers”).

The *oviducal pore* is median.

There is a *single pair of spermathecal pores* between segments vii./viii., which, however, are not recognizable externally.

The *clitellum* presents no chætæ and occupies the normal position.

The *first dorsal pore* is xii./xiii.

There is no gap in the circle of *chætæ*, which are rather closer together ventrally, and number

On segment ii.	38.
”	vi. 62.
”	xiii. 68.
”	xxvi. 78.

Internal Anatomy.—There is only a *single pair of spermatheca* in segment viii.; the sac is characteristically shaped, being oval, but with the narrowed free end somewhat constricted off. The duct is fairly long; the diverticulum, not so long as the sac, is dilated distally and curved; its duct is slightly zigzag (fig. 4 *d*).

The *sperm-sacs* are large and rounded, in the usual segments.

The *spermiducal gland* is large and occupies three segments—xvi., xvii., xviii. It is roughly divided into two main lobes: one in xvi. and xvii. is nearly square; the other in xviii. is partially concealed by the duct; each lobe is incised, though not to a great extent (fig. 4 *c*). The duct is strongly curved after leaving the gland, rises up vertically, and then proceeds almost directly to the body-wall; there is no “muscular sac.”

In the normal position, when first opened, the duct extended laterally beyond the outer margin of the gland; in the figure it is represented as having been lifted up.

The *cæcum*, arising in segment xxvii., runs through xxvi. into xxv.; it is simple and not notched.

The diagnosis of the species is as follows:—

Alternate dark purple intersegmental and yellowish-white broad chætal bands; measures 200 × 6 millim.; 120

* The lithographer has, in error, put 11 in the fig. 4 *b*.

segments. Male pores crescentic, far apart; outer lip rounded, overhanging the pore, with a small cup-shaped papilla at the tip; a pair of similar but larger papillæ on xviii. in front of the chætal ring. A single pair of spermathecæ in viii. with anterior pore; sac pyriform, with distinct duct, receiving undulating diverticulum with terminal sausage-shaped dilatation. Ring of chætæ without gaps; about 65 in front of and 78 behind clitellum. Dorsal pore xii./xiii. The cæcum in xxvii., simple. Spermiducal gland large, occupying xvi., xvii., xviii., in two lobes, each incised; long duct curved, without muscular sac (bulb).

Hab. Bonthain Peak, 6000 feet, Celebes.

Perichæta, sp. juv.

Two immature specimens were collected on Bonthain Peak; there is no trace of a clitellum.

In colour this species resembles the preceding worm and our "Brandling" *A. fatida*, that is, there are alternate bands of dark red-brown and yellow; but, as in other species of *Perichæta*, the light band is at the level of the chætæ; the dark bands are in the anterior segments subdivided by a narrow light intersegmental band. Behind the clitellum these dark bands are connected along the mid-dorsal line, so as to give the appearance of a dark line along the back. The coloured bands do not extend downwards beyond the "lateral line," *i. e.* halfway round the worm, so that the ventral surface is quite pale, with the exception of the three or four most anterior segments.

The worms measure respectively 84 and 90 millim.; the number of segments in the smaller worm is 133—that is, a larger number than in the larger species, *P. zebra*.

There is nothing noticeable about the male pores.

There is one pair of spermathecal pores, vii./viii.

The first dorsal pore is xii./xiii.

There is a distinct dorsal gap in the ring of chætæ, which number about the same as in *P. zebra*, *viz.* :—

62 on segment iv.

81 about " xx.

These are evidently young individuals, and I have not attempted to place them in a species, though in all probability they belong to *P. zebra*.

Perichæta purpurea, sp. n. (Pl. XXI. fig. 6.)

There are three specimens of this species. The colour of the worm is deep purple, with only very slightly lighter chætal bands, not recognizable anteriorly, so that this region appears continuously purple; the light bands are plain, but narrow, posteriorly, which is not lighter than the anterior end. The clitellum is of almost the same colour as the rest of the body. The dark bands become lighter on ventral surface, but can be seen to extend round the body.

The worms measure respectively 72, 90, and 95 × 5 millim.; the last worm consists of 116 segments.

The prostomium is embedded in one third of the first segment, and marked off by a transverse line from the latter.

The *male pores* are fairly distinct though small slits, not on a tumid papilla. There are five chætae between the pores (fig. 6 b).

This species is characterized by the number and arrangement of the copulatory papillæ. In segment xviii., both at the outer and at the inner end of each male pore, is a small pitted papilla. On segment xvii. there is a pair of similar but slightly larger papillæ just behind the chætal ring, in a line with the inner (mediad) papillæ of segment xviii. In segment xix. there is a similar pair of papillæ, similarly situated. There are thus eight papillæ, four on segment xviii. and two on each of the segments xvii. and xix. Further, there is a pair of papillæ on each of the segments viii. and ix., situated just behind the spermathecal pores and lying in front of the chætae of these segments.

There are two pairs of *spermathecal pores* between segments vii./viii., viii./ix., with about a dozen chætae between them.

These pores and the papillæ lie in a light brown glandular area, nearly square in shape, extending from the chætal ring on segment vii. to that on ix. (fig. 6 a).

The *oviducal pore* normal.

Clitellum normal, without chætae.

The first *dorsal pore* is xi./xii.

The *chætae* form a complete ring and number

34 on segment ii.

54 " vi.

70 " xiii.

70 " xxv.

Internal Anatomy.—None of the septa are noticeably thick, though those between segments x.xi., xi./xii. are rather stouter than the rest.

The gizzard has the usual bell-shape and lies in the usual

segments. The pair of cæca arise in segment xxvii., pass through segments xxvi. and xxv., and are constricted at the septa; each is a simple sac.

The sperm-sacs are in segments xi., xii., and were hidden by great quantities of gregarine and nematode cysts, which are definitely external to the sperm-sacs.

The *spermathecæ* are in segments viii. and ix.; the sac is globular, with a duct nearly half its length, and a diverticulum narrow, nearly straight, but strongly curved at its end, so as to resemble a golfing-club (fig. 6*d*). It is longer than the sac and its duct. The sac and diverticulum were very conspicuous, owing to the white contents; when teased, the sac was found to contain, as usual, granular coagulated substance; the spermatozoa are confined to the diverticulum, and in the enlarged terminal region are definitely arranged, all the heads being densely packed against the wall, with the tails towards the centre. It seemed to me that the heads of the spermatozoa are different from those of *Lumbricus* in being pointed and curved and shorter. In the duct of the diverticulum the spermatozoa are quite loosely and irregularly arranged, and it appears as if they were making their way upwards into the dilatation, where they will be probably attracted by some chemotaxic property of the epithelial cells, which secrete a fluid to bind them together in a kind of spermatophore.

The *spermiducal gland* is relatively small, and deeply lobed in a somewhat fan-shaped fashion; the duct is long, sharply bent upon itself soon after leaving the gland, and then running nearly directly to the body-wall (fig. 6*e*).

The structure of the copulatory papillæ could not be properly studied owing to the imperfect preservation of the worm; but each consists essentially of clitellar cells, the epidermis becoming suddenly thickened to about three times the usual depth; there is also a good deal of cellular tissue developed amongst the circular muscles, reminding one of the histological condition of the "capsulogenous glands" of the common earthworm.

This species may be diagnosed as follows:—

Deep purple; not banded; measures 70–95 × 5 millim.; 116 segments. Male pores slit-like, not on a papilla; separated by 5 chætæ. There is a cup-shaped papilla laterad and mediad of each pore. A pair of similar papillæ on xvii. and xix. behind the chætal ring. Two pairs of spermathecæ in viii. and ix., open anteriorly; pores conspicuous; each of these segments carries a pair of cup-shaped papillæ; the whole in a

rectangular brown area. Each spermatheca consists of a globular sac, with a narrow duct half its length, and a long straight diverticulum, longer than sac, with a terminal expansion sharply curved. The chætæ are about 50 in front of and 70 behind the clitellum. The dorsal pore is xi./xii. Paired cæca, simple, in xxvii. Spermiducal gland small, oval, deeply incised to form a number of radiating lobules; duct long, narrow, S-shaped, with sharp bends. No bulb.

Hab. Bonthain Peak, 6000 feet, Celebes.

EXPLANATION OF PLATES XX. & XXI.

PLATE XX.

Fig. 1. Perichæta jampeana.

1 *a.* View of male pores (σ), $\times 3$. (The lithographer has, in error, put 16 chætæ between the pores instead of 13.)

1 *b.* Spermiducal gland, $\times 8$. *gl*, the main part of the gland; *gl'*, a small piece underlying the penial duct and protruding beyond it.

1 *c.* Spermatheca.

Fig. 2. Perichæta digitata.

2 *a.* Spermiducal gland.

2 *b.* Spermatheca.

2 *c.* Cæcum (*c*), with neighbouring part of intestine. The septa (*s*) are inserted in the dilatations and not in the constrictions of the intestine.

Fig. 3. Perichæta bonthainensis.

3 *a.* View of the male pores (σ) and copulatory papillæ, $\times 4$. *po*, porophore.

3 *b.* Spermiducal gland, $\times 4$. *spd.*, sperm-duct.

3 *c.* Intestinal cæcum.

3 *d.* View of the posterior end of the worm from behind, to show the horizontal anus (*a*). *d.p.*, dorsal pores.

PLATE XXI.

Fig. 3 e. The septal pouches of some of the anterior segments. *p*, the bifid pouch in segment xvi.; *p'*, other pouches in succeeding segments; *o*, opening of pouches through the septa into the segments; *d.v.*, dorsal vessel; *int*, intestine; *s*, septa.

Fig. 4. Perichæta zebra.

4 *a.* Side view in middle region of the body, to show characteristic colour-bands, $\times 4$.

4 *b.* Ventral view, showing male pores (σ) and copulatory papillæ, $\times 5$.

4 *c.* A spermiducal gland, $\times 4$.

4 *d.* A spermatheca.

Fig. 5. Perichæta hexatheca.

5 *a.* Ventral view, to show the male pores (σ) and copulatory papillæ.

5 *b.* Spermiducal gland, $\times 3$.

Fig. 5 c. The hindmost spermatheca of the left side.

5 d. Dissection of the right side, the alimentary canal being turned aside, to show the six spermathecae in segments iv. to ix., $\times 3\frac{1}{2}$. s, septa; n, nerve-cord.

5 e. The intestinal caecum (c) of the left side, seen in side view. d.v., dorsal blood-vessel; n, ventral nerve-cord.

Fig. 6. *Perichæta purpurca*.

6 a. View of the spermathecal pores, with the anterior copulatory papillæ (pa), in the glandular area (gl), $\times 8$.

6 b. View of male pores (σ) and posterior copulatory papillæ, $\times 8$.

6 c. Spermiducal gland.

6 d. Spermatheca.

LXV.—*On Coleoptera from Aden and Somaliland*. By C. J. GAHAN, M.A., of the British Museum (Natural History).

THE following paper contains an account of two separate collections of Coleoptera—one made by Lieut.-Colonel Yerbury, R.A., at Aden and the surrounding district, the other by Mr. E. Lort Phillips in Somaliland. These collections have been presented to the Trustees of the British Museum, and comprise a number of interesting species, which, in addition to those described as new, had not previously been represented in the National Collection. In deference to the wishes of the donors, and in view of the faunistically interesting nature of the localities, I have endeavoured to make the lists of species as complete as possible. One genus and species of Buprestidæ from Aden and a few species of other families still remain undetermined; but even with those omitted the list of species from Aden &c. will show that Lieut.-Colonel Yerbury's collection is one of the largest yet made in that locality.

List of the Species collected by Lieut.-Colonel Yerbury at Aden and Lahej.

CICINDELIDÆ.

Cicindela alboguttata, Klug. Aden and Lahej.

— *aulica*, Dej. Aden.

— *melancholica*, Dej. Lahej.

— *rectangularis*, Klug. Aden and Lahej.

— sp.

— *inmanis*, Bates. Lahej.

CARABIDÆ.

Anthia 12-guttata, Bon. Lahej.

Calleida sp. Aden.

Cynindis sp. Lahej.